CLAIM AMENDMENTS

Claims 1 to 87 (cancelled)

88. (Original) A three-dimensional optical memory comprising fluorescent photosensitive glass, wherein said glass comprises at least one of two or more rare earths selected from the group consisting of ytterbium (Yb), samarium (Sm), and combinations thereof; and at least one of two or more rare earths selected from a group consisting of erbium (Er), holmium (Ho), samarium (Sm), dysprosium (Dy), Terbium (Tb), neodymium (Nd) and combinations thereof.

89. (Original) A three-dimensional optical memory of fluorescent photosensitive glass according to claim 88 wherein said glass further comprises about 10 mole percent to about 80 mole percent SiO_2, up to about 54 mole percent K_2O, up to about 58 mole percent Na_2, up to about 35 mole percent Li_2O, up to about 40 mole percent BaO, up to about 40 mole percent SrO, up to about 56 mole percent CaO, up to about 42 mole percent MgO, up to about 48 mole percent ZnO and up to about 5 mole percent of said two or more rare earths in oxide form.

90. (Original) A three-dimensional optical memory of fluorescent photosensitive glass according to claim 88 wherein said glass further comprises about 20 mole percent to about 80 mole percent P_2O_5, up to about 47 mole percent K_2O, up to about 60 mole percent Na_2O, up to about 60 mole percent Li_2O, up to about 58 mole percent BaO, up to about 56 mole percent SrO, up to about 56 mole percent CaO, up to about 60 mole percent MgO, up to about 64 mole percent ZnO, up to about 5 mole percent yttrium (Y) ytterbium, and up to about 5 mole percent of said two or more rare earths in oxide form.

91. (Original) A three-dimensional optical memory comprising fluorescent photosensitive vitroceramic, wherein said vitroceramic comprises one or more photosensitizing metals and one or more rare earths, one or more photosensitizing metals is selected from the group consisting of gold (Au), copper (Cu) and combinations thereof; and one or more rare earths is selected from the group consisting praseodymium (Pr), dysprosium (Dy), erbium (Er), holmium (Ho), europium (Eu), thulium (Tm) and combinations thereof.

92. (Original) The three-dimensional optical memory of fluorescent photosensitive vitroceramic according to claim 91 wherein said vitroceramic further comprises, in mole percent, about 10% to about 60% SiO2, about 5% to about 60% PbF_2, about 0.05% to about 0.3% Sb_20_3, up to about 0.5% CeO_2, up to about 60% CdF_2, up to about 30% $Ge0_2$ up to about 10% TiO_2, up to about 10% ZrO_2, up to about 40% Al_20_3, up to about 40% Ga_20_3, and about 10% to about 30% $Ln1F_3$ where Ln1 is selected from the group consisting of yttrium (Y) and ytterbium (Yb).

93. (Original) The three-dimensional optical memory of fluorescent photosensitive vitroceramic according to claim 92 wherein said Ln1 comprises ytterbium (Yb) and said Ln2 is selected from the group consisting of Er, Ho, Tm and combinations thereof; whereby said vitroceramic is capable of converting incident infra-red radiation into visible light.

94. (Original) The three-dimensional optical memory of fluorescent photosensitive vitroceramic according to claim 93 wherein said Ln1 comprises yttrium (Y) and said Ln2 is selected from the group consisting of Pr, Dy, Ho, Er, Eu, Tm and combinations thereof; whereby said vitroceramic is capable of converting incident ultraviolet light into visible light.

95. (New) A data storage and retrieval system for storing information on, and retrieving information from, a three-dimensional fluorescent photosensitive optical memory, said system comprising:

(a) a first coherent light beam generator in the form of a first Ti:sapphire laser for generating a first coherent light beam;

(b) a second coherent light beam generator in the form of a second Ti:sapphire laser for generating a second coherent light beam; and

c) an optical positioning system for directing said first coherent light beam and said second coherent light beam to irradiate an individually selected volume of said optical memory to produce a change in fluorescence characteristics in said selected volume.

96. (New) A data storage and retrieval system for storing information on, and retrieving information from, a three-dimensional fluorescent photosensitive optical memory, said system comprising:

(a) a first coherent light beam generator for generating a first coherent light beam;

(b) a second coherent light beam generator for generating a second coherent light beam; and

c) an optical positioning system for directing said first coherent light beam and said second coherent light beam to irradiate an individually selected volume of said optical memory to produce a change in fluorescence characteristics in said selected volume; and

(d) an optical focusing system comprising a confocal microscope for focusing said first coherent light beam and said second coherent light beam on said optical memory.

97. (New) A data storage and retrieval system for storing information on, and retrieving information from, a three-dimensional fluorescent photosensitive optical memory, said system comprising:

(a) a coherent light beam generator for generating a coherent light beam; and

(b) an optical positioning system for directing said coherent light beam to irradiate an individually selected volume of

said optical memory to produce a change in fluorescence characteristics in said selected volume.

98. (New) The data storage and retrieval system according to claim 97 wherein said coherent light beam generator irradiates said individually selected volume of said optical memory with said coherent light beam at a predetermined writing wavelength to cause a change in fluorescence characteristics in said selected volume.

99. (New) The data storage and retrieval system according to claim 97 further comprising an optical focusing system for focusing said coherent light beam on said optical memory.

100. (New) The data storage and retrieval system according to claim 99 wherein said optical focusing system comprises a confocal microscope.

101. (New) The data storage and retrieval system according to claim 97 wherein said optical positioning system further comprises a vertical scanning system to position said coherent light beam along a vertical axis of said optical memory.

102. (New) The data storage and retrieval system according to claim 97 wherein said optical positioning system further comprises a radial scanning system to position said coherent light beam along a radial axis of said optical memory.

103. (New) The data storage and retrieval system according to claim 97 wherein said optical positioning system further comprises a motor to rotate said optical memory.

104. (New) The data storage and retrieval system according to claim 97 wherein said coherent light beam generator is a laser.

105. (New) The data storage and retrieval system according to claim 104 wherein said laser is a Ti: sapphire laser.

106. (New) The data storage and retrieval system according to claim 104 wherein said laser is a pulse laser.

107. (New) The data storage and retrieval system according to claim 97 further comprising a reading system for reading information from said optical memory, said reading system comprising:

(a) a reading light beam generator for generating a reading light beam to excite at least an individually selected volume of said optical memory with said reading light beam at a predetermined reading wavelength; and

(b) a detector for detecting fluorescence in at least said individually selected volume.

108. (New) The data storage and retrieval system according to claim 107 wherein said reading light beam generator excites a volumetric slice of said optical memory with said reading light beam, said volumetric slice including multiple individual volumes.

109. (New) The data storage and retrieval system according to claim 107 wherein said reading light beam generator is a coherent light beam generator.

110. (New) The data storage and retrieval system according to claim 109 wherein said coherent light beam generator is a laser.

111. (New) The data storage and retrieval system according to claim 109 wherein said laser is a Ti: sapphire laser.

112. (New) The data storage and retrieval system according to claim 109 wherein said laser is a pulse laser.

113. The data storage and retrieval system according to claim 107 further comprising an optical focusing system for focusing said coherent reading light beam on at least individually selected volume of said optical memory.

114. The data storage and retrieval system according to claim 113 wherein said optical focusing system comprises a confocal microscope.

115. The data storage and retrieval system according to claim 107 further comprising a vertical scanning system to position said reading light beam along a vertical axis of said optical memory.

116. The data storage and retrieval system according to claim 107 further comprising a radial scanning system to position said reading light beam along a radial axis of said optical memory.

117. The data storage and retrieval system according to claim 107 further comprising a radial scanning system to position said detector along a radial axis of said optical memory.

118. The data storage and retrieval system according to claim 107 further comprising a motor to rotate said optical memory.

119. The data storage and retrieval system according to claim 97 wherein said fluorescent photosensitive optical memory comprises glass, said glass comprises two or more rare earths, at least one of said two or more rare earths is selected from the group consisting of europium (Eu), ytterbium (Yb), samarium (Sm), and combinations thereof; and at least one of said two or more rare earths is selected from a group consisting of erbium (Er), thulium (Tm), ytterbium (Yb), holmium (Ho), samarium (Sm), dysprosium (Dy), terbium (Tb), neodymium (Nd) and combinations thereof.

120. (New) The data storage and retrieval system according to claim 119 wherein said glass further comprises about 10 mole percent to about 80 mole percent SiO_2, up to about 54 mole percent K20, up to about 58 mole percent Na_2O, up to about 35 mole percent Li2O, up to about 40 mole percent BaO, up to about 40 mole percent SrO, up to about 56 mole percent CaO, up to about 42 mole percent MgO, up to about 48 mole percent ZnO and up to about 5 mole percent of said two or more rare earths in oxide form.

121. (New) The data storage and retrieval system according to claim 119 wherein said glass further comprises about 20 mole percent to about 80 mole percent P_2O_3, up to about 47 mole percent K_2O, up to about 60 mole percent Na_2O, up to about 60 mole percent Li_2O, up to about 58 mole percent BaO, up to about 56 mole percent SrO, up to about 56 mole percent CaO, up to about 60 mole percent MgO, up to about 64 mole percent ZnO, up to about 5 mole percent yttrium (Y), and up to about 5 mole percent of said two or more rare earths in oxide form.

122. (New) The data storage and retrieval system according to claim 97 wherein said fluorescent photosensitive memory comprises vitroceramic, said vitroceramic comprises one or more photosensitizing metals selected from the group consisting of silver (Ag), gold (Au), copper (Cu) and combinations thereof; and one or more rare earths selected from the group consisting of praseodymium (Pr), dysprosium (Dy), erbium (Er), holmium (Ho), europium (Eu), thulium (Tm) and combinations thereof.

123. (New) The data storage and retrieval system according to claim 122, wherein said vitroceramic further comprises, in mole percent, about 10% to about 60% SiO2, about 5% to about 60% PbF_2, about 0.05% to about 0.3% Sb_2O_3, up to about 0.5% CeO_2, up to about 60% CdF_2, up to about 30% GeO_2 up to about 10%

TiO_2, up to about 10% ZrO_2, up to about 40% Al_2O_3, up to about 40% Ga_2O_3, and about 10% to about 30% $Ln1F_3$ where Ln1 is selected from the group consisting of yttrium (Y) and ytterbium (Yb).

124. (New) The data storage and retrieval system according to claim 123, wherein said Ln1 comprises ytterbium (Yb) and said Ln2 is selected from the group consisting of Er, Ho, Tm and combinations thereof; whereby said vitroceramic is capable of converting incident infrared radiation into visible light.

125. (New) The data storage and retrieval system according to claim 124, wherein said Ln1 comprises yttrium (Y) and said Ln2 is selected from the group consisting of Pr, Dy, Ho, Er, Eu, Tm and combinations thereof; whereby said vitroceramic is capable of converting incident ultraviolet light into visible light.

126. (New) A data retrieval system for reading information from a three-dimensional fluorescent photosensitive optical memory, said retrieval system comprising:

(a) a reading light beam generator for generating a reading light beam to excite at least an individually selected volume of said optical memory with said reading light beam at a predetermined reading wavelength; and

(b) a detector for detecting fluorescence in at least said individually selected volume.

127. (New) The data retrieval system according to claim 126 wherein said reading light beam generator is a coherent light beam generator.

128. (New) The data retrieval system according to claim 127 wherein said coherent light beam generator is a laser.

129. (New) The data retrieval system according to claim 128 wherein said laser is a Ti: sapphire laser.

130. (New) The data retrieval system according to claim 128 wherein said laser is a pulse laser.

131. (New) The data retrieval system according to claim 129 further comprising an optical focusing system for focusing said reading light beam on said individually selected volume of said optical memory.

132. (New) The data retrieval system according to claim 131 wherein said optical focusing system comprises a confocal microscope.

133. (New) The data retrieval system according to claim 126 further comprising a vertical scanning system to position said reading light beam along a vertical axis of said optical memory.

134. (New) The data retrieval system according to claim 126, further comprising a radial scanning system to position said reading light beam along a radial axis of said optical memory.

135. (New) The data retrieval system according to claim 126 wherein said fluorescent photosensitive memory comprises glass, said glass comprises two or more rare earths, at least one of said two or more rare earths is selected from the group consisting of europium (Eu), ytterbium (Yb), samarium (Sm), and combinations thereof; and at least one of said two or more rare earths is selected from a group consisting of erbium (Er), thulium (Tm), ytterbium (Yb), holmium (Ho), samarium (Sm), dysprosium (Dy), terbium (Tb), neodymium (Nd) and combinations thereof.

136. (New) The data retrieval system according to claim 135 wherein said glass further comprises about 10 mole percent to about 80 mole percent Si_o2, up to about 54 mole percent K_20, up to about 58 mole percent Na_2O, up to about 35 mole percent Li_2O, up to about 40 mole percent BaO, up to about 40 mole percent SrO, up to about 56 mole percent CaO, up to about 42 mole percent MgO, up to about 48 mole percent ZnO and up to about 5 mole percent of said two or more rare earths in oxide fin.

137. (New) The data retrieval system according to claim 135, wherein said glass further comprises about 20 mole percent to about 80 mole percent 45 up to about 47 mole percent K_20, up to about 60 mole percent Na_2O, up to about 60 mole percent Li_2O, up to about 58 mole percent BaO, up to about 56 mole percent SrO, up to about 56 mole percent CaO, up to about 60 mole percent MgO, up to about 64 mole percent ZnO, up to about 5 mole percent yttrium (Y), and up to about 5 mole percent of said two or more rare earths in oxide form.

138. The data retrieval system according to claim 126, wherein said fluorescent photosensitive memory comprises vitro-ceramic, said vitroceramic comprises one or more photosensitizing metals selected from the group consisting of silver (Ag), gold (Au), copper (Cu) and combinations thereof ; and one or more rare earths selected from the group consisting of praseodymium (Pr), dysprosium (Dy), erbium (Er), holmium (Ho), europium (Eu), thulium (Tm) and combinations thereof.

139. (New) The data retrieval system according to claim 138, wherein said vitroceramic further comprises, in mole percent, about 10% to about 60% SiO_2, about 5% to about 60% PbF_2, about 0.05% to about 0.3% Sb_2O_3, up to about 0.5% CeO_2, up to about 60% CdF_2, up to about 30% GeO_2, up to about 10% TiO_2, up to about 10% ZrO2, up to about 40% Al_2O_3, up to about 40% Ga_2O_3, and about 10% to about 30% $Ln1F_3$ where Lnl is selected from the group consisting of yttrium (Y) and ytterbium (Yb).

140. (New) The data retrieval system according to claim 139, wherein said Lnl comprises ytterbium (Yb) and said Ln2 is selected from the group consisting of Er, Ho, Tm and combinations thereof, whereby said vitroceramic is capable of converting incident infrared radiation into visible light.

141 (New) The data retrieval system according to claim 139, wherein said Ln1 comprises yttrium (Y) and said Ln2 is selected from the group consisting of Pr, Dy, Ho, Er, Eu, Tm and combinations thereof; whereby said vitroceramic is capable of converting incident ultraviolet light into visible light.

142. (New) A method for retrieving data from a fluorescent photosensitive three-dimensional optical memory, said method comprising:

(a) generating a reading light beam;

(b) exciting at least an individually selected volume of said optical memory with said reading light beam at a predetermined reading wavelength; and

c) detecting fluorescence in at least said individually selected volume.

143. (New) The method for retrieving data according to claim 142 further comprising generating said reading light beam from a coherent light beam generator.

144. (New) The method for retrieving data according to claim 142 comprising generating said reading light beam from a laser.

145. (New) The method for retrieving data according to claim 144 comprising generating said reading light beam from a Ti: sapphire laser.

146. (New) The method for retrieving data according to claim 144 comprising generating said reading light beam from a pulse laser.

147. (New) The method for retrieving data according to claim 142 comprising detecting fluorescence in at least said individually selected volume using a detector.

148. (New) The method for retrieving data according to claim 142 further comprising focusing said reading light beam on said optical memory.

149. (New) The method for retrieving data according to claim 148 wherein said focusing further comprises using a confocal microscope.

150. (New) The method for retrieving data according to claim 142 further comprising position said reading light beam along a vertical axis of said optical memory using a vertical scanning system.

151. (New) The method for retrieving data according to claims 142 further comprising positioning said reading light beam along a radial axis of said optical memory using a radial scanning system.

152. (New) The method for retrieving data according to claim 142, comprising providing a fluorescent photosensitive memory comprising glass, said glass comprising using two or more rare earths, selecting at least one of said two or more rare earths from the group consisting of europium (Eu), ytterbium (Yb), samarium (Sm), and combinations thereof, and selecting at least one of said two or more rare earths from a group consisting of erbium (Er), thulium (Tm) ytterbium (Yb), holmium (Ho), samarium (Sm), dysprosium (Dy), terbium (Tb), neodymium (Nd) and combinations thereof.

153. (New) The method for retrieving data according to claim 152, comprising using glass further comprising about 10 mole percent to about 80 mole percent SiO2, up to about 54 mole percent K20, up to about 58 mole percent Na2O, up to about 35 mole percent Li2O, up to about 40 mole percent BaO, up to about 40 mole percent SrO, up to about 56 mole percent CaO, up to about 42 mole percent MgO, up to about 48 mole percent ZnO and up to about 5 mole percent of said two or more rare earths in oxide form.

154. (New) The method for retrieving data according to claim 152 comprising using glass further comprising about 20 mole percent to about 80 mole percent P_2O_3 up to about 47 mole percent K_2O, up to about 60 mole percent Na_2O, up to about 60 mole percent Li_2O, up to about 58 mole percent BaO, up to about 56 mole percent SrO, up to about 56 mole percent CaO, up to about 60 mole percent MgO, up to about 64 mole percent ZnO, up to about 5 mole percent yttrium (Y), and up to about 5 mole percent of said two or more rare earths in oxide form.

155. (New) The method for retrieving data according to claim 142, providing a fluorescent photosensitive memory comprising vitroceramic, said vitroceramic comprising using one or more photosensitizing metals and one or more rare earths, selecting one or more said photosensitizing metals from the group consisting of

silver (Ag), gold (Au), copper (Cu) and combinations thereof; and selecting one or more said rare earths from the group consisting of praseodymium (Pr), dysprosium (Dy), erbium (Er), holmium (Ho), europium (Eu), thulium (Tm) and combinations thereof.

156. (New) The method for retrieving data according to claim 155, comprising using said vitroceramic further comprising, in mole percent, about 10% to about 60% SiO_2, about 5% to about 60% PbF_2, about 0.05% to about 0.3% Sb_2O_3, up to about 0.5% CeO_2, up to about 60% CdF_2, up to about 30% GeO_2 up to about 10% TiO_2, up to about 10% ZrO_2, up to about 40% Al_2O_3, up to about 40% Ga_2O_3, and about 10% to about 30% $LnIF_3$ where Lnl is selected from the group consisting of yttrium (Y) and ytterbium (Yb).

157. (New) The method for retrieving data according to claim 156, comprising using vitroceramic wherein said Lnl comprises ytterbium (Yb) and said Ln2 is selected from the group consisting of Er, Ho, Tm and combinations thereof, whereby said vitroceramic is capable of converting incident infrared radiation into visible light.

158. The method for retrieving data according to claim 152, comprising using vitroceramic wherein said Ln1 comprises yttrium (Y) and said Ln2 is selected from the group consisting of Pr, Dy, Ho, Er, Eu, Tm and combinations thereof; whereby said vitroceramic is capable of converting incident ultraviolet light into visible light.